Glass and Ceramics, Vol. 68, Nos. 9 – 10, January, 2012 (Russian Original, Nos. 9 – 10, September – October, 2011)

MATERIALS PROCESSING

UDC 666.1.053.5:621.921.34

DIAMOND WHEELS WITH ORGANIC BINDER FOR PRE-GRINDING HIGH-GRADE AND ART GLASS

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Translated from *Steklo i Keramika*, No. 9, pp. 20 – 22, September, 2011.

It is shown that the organic binder MV1with diamond powder with grain size 90/70 μm and concentration 150% is best for preliminary diamond grinding of high-grand and art glass, followed by chemical polishing. MV1 organic binder for wheels with diamond grinding powder with grain size 90/75 μm and concentration 150% used instead of M2-01 binder with grain size of the diamond powder 53/45 μm and concentration 50% made it possible to increase the productivity of preliminary diamond grinding of high-grade and art glass followed by chemical polishing by 20 – 25% and to increase the wheel longevity by a factor of 1.8 – 2.3 with the same wheel production cost and worked-surface roughness.

Key words: grinding, diamond wheel, organic binder, relative consumption of diamonds, cutting capacity.

Preliminary grinding of high-grade and art glass prior to subsequent chemical polishing is done with diamond wheels with metallic binders. The desirability of using wheels with organic binders for finish grinding of high-grade and art glass without subsequent chemical polishing is substantiated in [1]. The present study is devoted to the development of diamond wheels with organic binder with the optimal concentration and grain size as a replacement for wheels with metallic binders to increase the efficiency pre-grinding glass.

The efficiency of diamond wheels with organic binder was improved by increasing the grain size and concentration of diamond powder. The following prerequisites form the basis for this.

1. It was established on [1] that the roughness of the worked surface when using wheels with organic binder with AS6 diamond powder is 1.3 – 1.5 times smaller than the roughness of a surface worked with wheels with metallic binder with AS20 diamond powder with the same grain size. This result shows that it is best to use considerably larger grain size in wheels with organic binder than in wheels with metallic binders to achieve the same worked-surface roughness.

2. Wheels with metallic binder are more expensive to manufacture than wheels with organic binder with the same diamond powder concentration. This is because wheels with metallic binder sinter at temperatures several-fold higher than the temperature at which wheels with organic binder sinter. For this reason, molds made of expensive refractory materials must be built to manufacture wheels with metal binders.

3. Grade AS6 diamond powder used to manufacture wheels with organic binders is much cheaper then grade AS20 powder used to manufacture wheels with metallic binder.

This shows that the diamond powder concentration in wheels with organic binder can be greatly increased as compared with wheels with metallic binder and similar manufacturing costs.

The optimal grain size and concentration of diamond powder in wheels with organic binder was studied for constant longitudinal feeding into a V3-318E universal cutting machine with GOST 16181–82 regulated hydraulic feeding. The serviceability of wheels with metallic and organic binders was compared by the GOST 30352–96 procedure on a special facility based on a universal cutting machine [1]. In this case the sample is clamped to the grinding wheel by counterweight acting through blocks placed on the bed of the machine and monitored with a dynamometer with graduation 1 N.

In the experiments the grinding depth was measured with a height-and-depth gauge with graduation 0.1 mm. The

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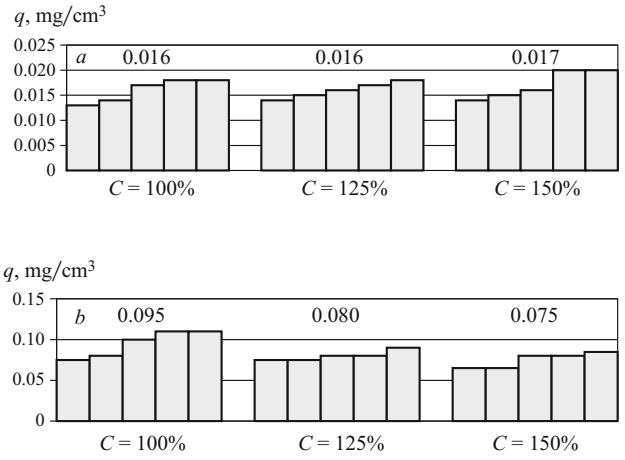

Fig. 1. Relative diamond consumption q versus the 90/75 μm grain-size AS6 diamond powder concentration C: *a*) 1A1 wheel; *b*) 1E1 wheel.

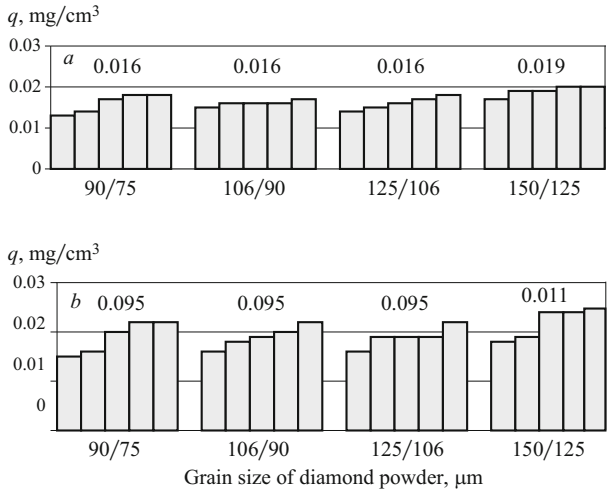

Fig. 2. Relative consumption q of diamonds versus the grain size of AS6 diamond powder with concentration C = 100%: *a*) 1A1 wheel; *b*) 1E1 wheel.

grinding was performed with 1A1 100 × 6 × 5 × 32 and 1E1 100 × 6 × 5 × 90 × 32 wheels with M2-01 metallic binder and AS20 diamond powder and with the new MV1 organic binder with hardness at least 1055HRB and AS6 diamond powder. The speed of the wheel was 26 m/sec. A 150 × 100 × 20 mm glass bar containing 24% PbO was ground using a water-based coolant. The relative consumption of diamonds was determined by weighing on VLT-1-1 scales. To determine the average relative consumption of diamonds and the cutting capacity of the wheel, each experiment was repeated at least five times. The roughness was measured with a model 201 profilograph-profilometer manufactured by the Kalibr Company.

Studies performed with constant longitudinal feeding speed 1000 mm/min and grinding depth 1 mm showed that increasing the concentration of the diamond powder from 100 to 150% in wheels with organic binder did not greatly change the relative consumption of diamonds in the 1A1 wheels (Fig. 1*a*). For the 1E1 wheels with constant feed rate 150 mm/min and grinding depth 1 mm it was found that increasing the concentration of diamond powder to 125% decreased the relative diamond consumption by 15%, while increasing the concentration to 150% decreased the relative diamond consumption by 20% as compared with the standard concentration 100% (Fig. 1*b*). This decrease of the relative consumption for 1E1 wheels is probably due to the greater edge stability of the wheels as concentration increases.

The studies showed that increasing the grain-size of AS6 diamond powder in wheels with organic binder from 90/75 to 150/125 μm did not decrease the relative consumption of diamonds in 1A1 (Fig. 2*a*) and 1E1 (Fig. 2*b*) wheels.

In summary, it is desirable to use diamond powder with grain size 90/75 μm and concentration 150% in wheels with organic binders for preliminary grinding of high-grade and art glass.

At the present time, mainly wheels with metallic binder and AS20 diamond powder [2] with grain size 53/45 μm [3] and diamond powder concentration 50% [4] are used to grind glass followed by chemical polishing. For this reason, we investigated the possibility of replacing 1E1 and 1A1grinding wheels with M2-01 binder with AS20 diamond grinding powder with grain size 53/45 μm and diamond powder concentration 50% with AS6 powder diamond grinding powder with grain size 90/75 μm with diamond powder concentration 150%.

For the tests of 1A1 wheels (Fig. 3) with grain size of the diamond powder 53/45 and 90/75 μm the clamping force was 40 N and the grinding depth was 2 mm. It was found that as a result of using MV1 binder with 90/75 μm diamond powder at concentration 150% instead of M2-01 binder with 53/45 μm diamond powder at concentration 50% it was possible to increase the grinding efficiency by 20 – 30% with the same worked-surface roughness and 55 – 60% higher diamond powder consumption. However, since a wheel with AS6 diamond powder and organic binder has 3 times more powder than a wheel with metallic binder, the longevity of the wheel with organic binder is 1.8 – 2 times greater than that of wheel with metallic binder.

In tests of 1E1 wheels (Fig. 4) with 53/45 and 90/75 μm diamond powder the clamping force was 40 N and the grinding depth was 3 mm. It was found that as a result of using MV1 binder with 90/75 μm diamond powder concentration 150% instead of M2-01 binder with 53/45 μm diamond powder concentration 50% increased the grinding efficiency by 25 – 30% with the same worked-surface roughness and 30 – 35% high relative consumption of diamond powder. However, since a wheel with organic binder contains 3 times more AS6 diamond powder than a wheel with metallic binder, the longevity of a wheel with organic binder is

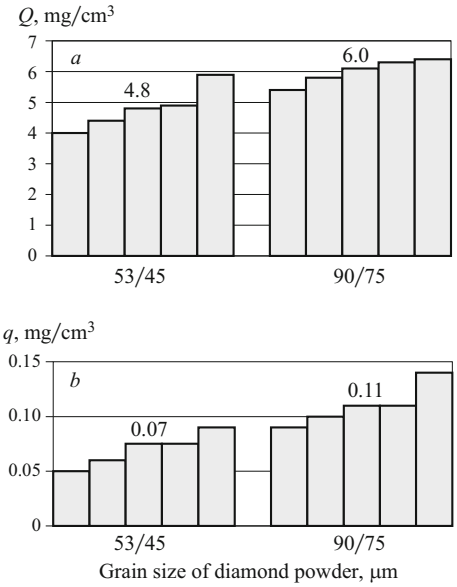

Fig. 3. Cutting capacity of a wheel Q (*a*) and relative diamond consumption q (*b*) for 1A1 wheels versus the grain size of the diamond powder.

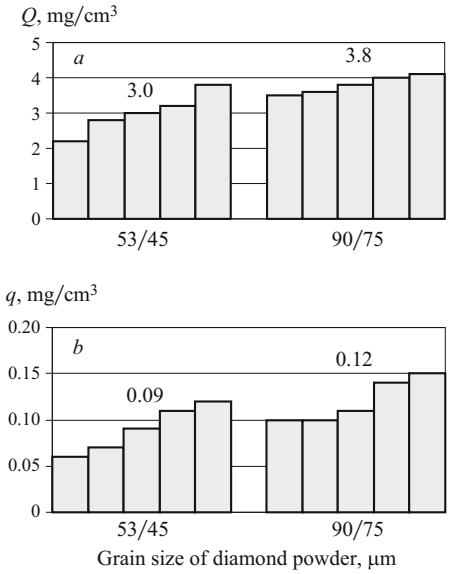

Fig. 4. Cutting capacity of a wheel Q (*a*) and relative diamond consumption q (*b*) for 1E1 wheels versus the grain size of the diamond powder.

2.2 – 2.3 times greater than that of a wheel with metallic binder.

The MV1 binder was recommended for commercial production of wheels to be used for preliminary grinding of high-grade and art glass followed by chemical polishing. At the present time wheels with MV1 binder are being successfully used in 10 enterprises in the Czech Republic.

These studies have shown that it is best to use the new MV1 organic binder with 90/75 μm diamond powder at concentration 150% for preliminary diamond grinding of high-grade and art glass followed by chemical polishing.

The use of MV1 organic binder for 1A1 wheels with 90/75 μm diamond grinding powder at concentration 150% instead of the M2-01 binder with 53/45ìm diamond powder at concentration 50% made it possible to increase the efficiency of preliminary diamond grinding of high-grade and art glass followed by chemical polishing by 20 – 30% and to increase wheel longevity 1.8 – 2-fold with the same wheel production costs and worked-surface roughness.

The use of MV1 organic binder for 1E1 wheels with 90/75 μm diamond powder at concentration 150% instead of M2-01 with 53/45 μm diamond powder at concentration 50% made it possible to increase the efficiency of preliminary diamond grinding of high-grade and art glass followed by chemical polishing by 30 – 35% and increase wheel longevity 2.2 – 2.3-fold with the same wheel production costs and worked-surface roughness.

This article was written as part of the MSM 4674788501 project of the MSMT ministry of the Czech Republic.

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